Applications of Fluorescence Spectroscopy to Predict Wastewater in an Urban Stream

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In an urban watershed, anthropogenic influences can cause detrimental effects on the region's rivers and streams and lead to negative impacts on water quality. Determining the water quality and health of these aquatic ecosystems requires identification of natural and anthropogenic influences and an understanding of the seasonal hydrologic cycle. Dissolved organic carbon (DOC) represents a significant carbon reservoir in all ecosystems and can be used as a means to measure the characteristics and sources of organic matter in aquatic environments. Fluorescence spectroscopy can be used to quantify and characterize a subset of the DOC pool, the colored dissolved organic matter (CDOM), which can absorb and re-emit energy as fluorescence. This study utilizes fluorescence spectroscopy to characterize organic carbon in the Portland, Oregon urban watershed temporally and spatially and traces the anthropogenic signature found in wastewater effluent associated with treatment plants. Samples were collected from multiple sites within and outside the urban area and from effluent of two different wastewater treatment plants. Several statistical approaches were used to develop a model to predict the amount of wastewater present in a stream sample: end-member mixing experiments were conducted to demonstrate the linearity of fluorescence; principle component analysis was used to distinguish sources and characteristics of the organic matter; and a multivariate linear regression model was built using three key fluorescence peaks to characterize the organic matter. The model was tested with independent data and predicts the percentage of wastewater in a sample within 80% confidence. The model results can be used to develop in-situ instrumentation, inform monitoring programs, and develop additional water quality indicators for aquatic systems.